Effect of Boiling on Yellow Onion Quercetin (Glucosides)

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Abstract: Flavonoids are a large group of secondary plant metabolites with hydroxyl groups. The flavonol quercetin is commonly found in onions. In the edible fleshy scales of yellow onions quercetin mono- and diglucosides are present. The aim of this work was to study quercetin glucosides during technological processing of yellow onion bulb. Onion was boiled in water under reflux for 30 min. The cooking was performed at three different onion/water ratios (1/5, 1/10, 1/20; w/w). The resulting soup, boiled onion solids and the control raw onion samples were lyophilised, extracted with ac. methanol and analysed for quercetin and its derivatives (3-β-D-glucoside, 4′-β-D-glucoside, 3,4′-β-D-glucoside) using HPLC-UV. Major flavonoid components identified in yellow onion were quercetin-4′-β-D-glucoside and 3,4′-β-D-glucoside with a decreasing concentration from outer toward inner rings of the raw bulb. These substances were rapidly transferred into cooking water during thirty minutes boiling making the resulting soup a good source of flavonoids. The effect of water amount added on flavonoid concentration was followed.

Keywords: cooking; flavonoid; onion; quercetin; processing

INTRODUCTION

Flavonoids are a large group of phytochemicals with hydroxyl groups available for binding. Indeed, these polyphenols are present in plants and plant-derived food predominantly in bound form as beta-glycosides. The flavonol quercetin is commonly found in onions with concentrations ranging from very low in white varieties to highest in yellow and red types. In the papery dry skin of yellow onions mainly quercetin aglycone (Q) is present, whereas the edible fleshy scales contain mono- and diglucosides (Q4′Glc, Q3,4′Glc – Figure 1). Out of total onion quercetin content, around 40% is lost by peeling and trimming [1], half of the remaining diglucoside is degraded during maceration [2], most likely due to beta-glucosidases in the onion plant tissue [3]. Cooking of onion does not result in deglycosylation, and the quercetin (glycosides) are transferred to soup. Microwaving may result in better extractability of flavonoids from onion [4]. The aim of the study was to follow quercetin

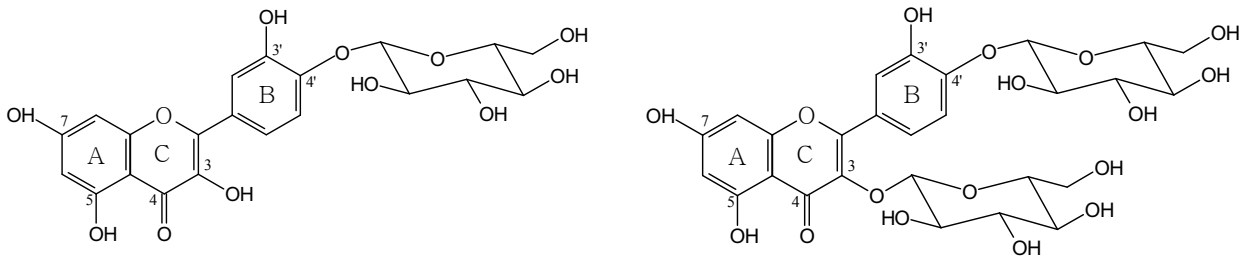

Figure 1. Chemical structures of main onion flavonoid constituents, quercetin-4′-glucoside (spiraeoside) and quercetin-3,4′-diglucoside

glucosides in raw onion and during boiling. After home-like cooking, however, the boiled onion is usually discarded. Therefore the effect of the water amount added for 'soup' preparation was also of interest.

EXPERIMENTAL

Materials and methods. For onion technology experiments, yellow onion variety was used with representative sample taken out of 20 kg. Onions were peeled to first edible scale (as in home-like cooking), the bulb was longitudinally cut into quarters. One quarter was kept as raw control, each of the three remaining quarters were used for cooking at three different onion/water ratios (1/5, 1/10, 1/20; w/w). Cooking experiments (30-min) were done in triplicates, with subsamples taken from the soup. Both onion and soup samples were freeze-dried.

Flavonoid HPLC analysis. Flavonoids were extracted with methanol/acetic acid 95/5 (v/v) and analysed on reversed-phase HPLC with UV detection according to Baczek *et al*. [5]. All chromatographic determinations were performed at 35°C with C18(2) LUNA 3µ column (150 × 2 mm, Phenomenex). Solvents A (0.05% formic acid/water, v/v) and B (acetonitrile) were run at 0.2 ml/min using a gradient of 14% B increasing to 24% B (14 min), 37% B (30 min), 80% B (1 min), hold on at 80% B (5 min), and then decreasing to 14% B (1 min), hold on at 14% B (19 min). Flavonoids standards were prepared as methanol stock solutions (stored at –20°C) and diluted to required concentrations using the solvent for extraction.

RESULTS AND DISCUSSION

Comparing the parts of raw onion, a gradient of flavonoid content from outer (expressed as 5.23 mg Q aglycone/g dry matter) to inner layers (90.69 µg Q/g d.m.) was found, in agreement with previous findings [6]. The outer layers were found to have the highest concentration of the two major quercetin derivatives, Q3,4'Glc and Q4'Glc and because of that these layers may serve as a concentrated source of dietary flavonoids. Therefore, the outer layer is the most important part of onion for quercetin enrichment of soup.

Flavonoids (Q3,4'Glc, Q4'Glc) and dry mass were rapidly washed out from onion tissue during 30-min boiling. Separation of the solids from the soup showed that as much as 59% of the quercetin derivatives and 54% of dry matter initially present in the onion outer layers were transferred to the soup during 30-min cooking at 5/1 water/onion ratio (w/w). Free quercetin and Q3Glc were minor constituents of raw onion and were not determined in soup. Transfer of dry mass into boiling water was proportional to the amount of water added for cooking (Figure 2).

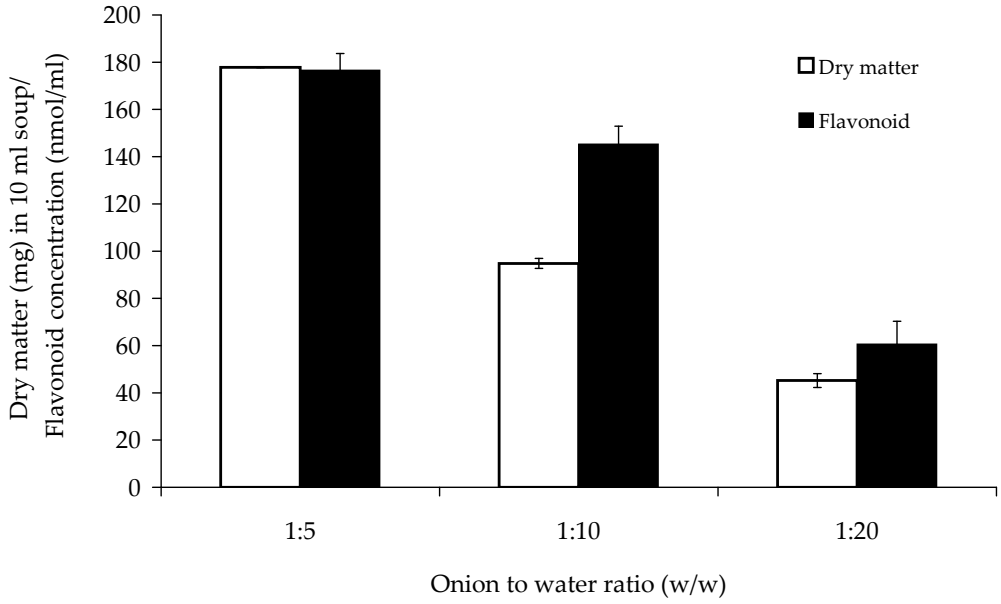

Figure 2. Transfer of dry mass and quercetin glucosides (Q3,4'Glc, Q4'Glc) into soup during the 30-min cooking period at various water/onion ratios (w/w)

Furthermore, relative proportion of the two major glucosides, Q3,4'Glc/Q4'Glc was followed in both raw and boiled onion and the corresponding soup (5/1, water/onion): 1.09, 0.87 and 1.34, respectively, suggesting that the diglucoside is transferred in larger proportions.

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